Journal of Adolescence 56 (2017) 166–178

Contents lists available at ScienceDirect

Journal of Adolescence

journal homepage: www.elsevier.com/locate/jado

Individual and contextual factors associated with tobacco, alcohol, and cannabis use among Chilean adolescents: A multilevel study

Jorge Gaete [a, b, *], Ricardo Araya [b]

[a] Departamento de Salud Pública y Epidemiología, Facultad de Medicina, Universidad de los Andes, Santiago, Chile
[b] Department of Population Health, London School of Hygiene and Tropical Medicine, London, United Kingdom

ARTICLE INFO

Article history:
Received 18 June 2016
Received in revised form 15 February 2017
Accepted 16 February 2017
Available online 1 March 2017

Keywords:
Substance use
Smoking
Drinking
Cannabis
Adolescents
Individual factors
Contextual factors

ABSTRACT

We studied the association between individual and contextual variables and the use of tobacco, alcohol, or cannabis in the last 30 days preceding the study, considering the hierarchical nature of students nested in schools. We used the 7th Chilean National School Survey of Substance Use (2007) covering 45,273 students (aged 12–21 years old) along with information from 1465 schools provided by the Chilean Ministry of Education. Multilevel univariable and multivariable logistic regression models were performed. We found a significant intra-class correlation within schools for all substances in the study. Common (e.g., availability of pocket money, more time spent with friends, poor parental monitoring, poor school bonding, bullying others, and lower risk perception of substance use) and unique predictors (e.g., school achievement on national tests) were identified. These findings may help in planning and conducting preventive interventions to reduce substance use.

1. Introduction

The use of tobacco, alcohol, or cannabis among Chilean adolescents is a major problem. The most recent prevalence survey conducted in Chile (2013) showed that 26.7% of 8th- (13–14 years old) through 12th-graders (17–18 years old) used cigarettes during the 30 days preceding the survey. The 30-day prevalence of alcohol and cannabis use were 35.6% and 18.8%, respectively (Servicio Nacional para la Prevención y Rahabilitación de Drogas y Alcohol (SENDA), 2013). The same figures in the United States for 2013 were 9.6% for cigarettes, 24.3% for alcohol, and 15.6% for cannabis (Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2016). In 2011, in Europe as a whole, 28% of students had smoked cigarettes, 57% had drunk alcohol, and 7% had used cannabis in the 30 days preceding the study. However, Europe had a large variation between countries.

Adolescence is a time of crucial developmental changes in the brain (Colver & Longwell, 2013; Luciana, 2013; Steinberg, 2013; Stiles & Jernigan, 2010; Wetherill & Tapert, 2013), and the use of a substance of abuse, specifically alcohol and cannabis,

* Corresponding author. Department of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, Keppel Street, London, WC1E 7HT, United Kingdom.
E-mail addresses: jorge.gaete@lshtm.ac.uk, jgaete@uandes.cl (J. Gaete).

http://dx.doi.org/10.1016/j.adolescence.2017.02.011

has a deleterious impact on brain functioning and structure (Battistella et al., 2014; Camchong, Lim, & Kumra, 2016; Jacobus, Squeglia, Bava, & Tapert, 2013; Lisdahl, Thayer, Squeglia, McQueeny, & Tapert, 2013; Lubman, Cheetham, & Yucel, 2015; Squeglia et al., 2012). Early substance abuse also has been associated with poor health and academic outcome (Ellickson, Tucker, Klein, & Saner, 2004; Hawkins et al., 1997). The study of the factors associated with adolescent drug use should aid development of more informed school-based preventive interventions.

Different individual, peer, and familial risk factors for substance misuse have been identified in several international studies (Berge, Sundell, Öjehagen, & Håkansson, 2016; Harakeh, de Looze, Schrijvers, van Dorsselaer, & Vollebergh, 2012; Hill & Mrug, 2015; Hughes, Lipari, & Williams, 2015; Kim & Chun, 2016; Moore & Littlecott, 2015; Park & Kim, 2015; Ryabov, 2015; Tomczyk, Hanewinkel, & Isensee, 2015; Walsh, Djalovski, Boniel-Nissim, & Harel-Fisch, 2014). The factors related to a higher frequency of smoking include getting into physical fights, experiencing anxiety (Kim & Chun, 2016), having a poorer perception of one's own health, and not progressing beyond a low educational level (Park & Kim, 2015). In addition, depressive mood was associated with alcohol, tobacco, and illegal drug use (Park & Kim, 2015). Having behavioral problems has been associated with drinking and cannabis use and peer smoking and drinking, and spending a lot of time with friends also has been associated with the use of multiple drugs (Harakeh et al., 2012; Tomczyk et al., 2015). Maternal drinking has been linked to smoking and drinking (Tomczyk et al., 2015), and having permissive parents has been associated with alcohol and cannabis use (Harakeh et al., 2012). On the other hand, authoritative parenting by parents who simultaneously provide both support and clear limits and norms was associated with less drinking (Berge et al., 2016). Many of these factors have been identified in other review studies (Monasterio, 2014; Tyas & Pederson, 1998).

Fewer studies have explored the association between school-related factors and substance use (Bonell et al., 2013; Fletcher, Bonell, & Hargreaves, 2008). The school climate is a strong and negative predictor of frequency of cannabis and other illicit drug use as well as of heavy episodic drinking (Ryabov, 2015). School socioeconomic status, independent of family income, has been associated with smoking and alcohol consumption (Moore & Littlecott, 2015). Commitment to school in high school appears to be strongly associated with a low risk of smoking (Gaete, Montgomery, & Araya, 2015), and strong anti-tobacco polices at school have been associated with less smoking (Galan et al., 2012; Paek, Hove, & Oh, 2013; Wiium, Burgess, & Moore, 2011).

Factor associations with the outcome cannot be considered as representing causal effects when using cross-sectional data. However, it is worth mentioning that, for example, in the case of youth antisocial behavior, some of the common risk factors found in observational studies to be associated (e.g., peer deviance) have a truly causal affect when studied using experimental or quasi-experimental studies or when applying some statistical innovations (Jaffee, Strait, & Odgers, 2012). Moreover, one Scottish longitudinal study found that smoking was more prevalent among students who reported disengagement with education and poor relationships with staff (West, Sweeting, & Leyland, 2004).

Studies exploring the association of such factors with substance use should consider the hierarchical nature of the data collected from schools (Aveyard, Markham, & Cheng, 2004; Aveyard, Markham, Lancashire et al., 2004; Hox, 2002). Pupil behaviors such as smoking and other substance misuse tend to be correlated within a school (Aveyard, Markham, & Cheng, 2004). Part of this correlation could be explained by the pupil composition, either by school selection or self-selection (e.g., family income, student academic performance) (Aveyard, Markham, & Cheng, 2004; Aveyard, Markham, Lancashire et al., 2004). However, part of this correlation may be explained by school contextual features independent of student characteristics (e.g., school location, school denomination, school size) (Aveyard, Markham, & Cheng, 2004; Aveyard, Markham, Lancashire et al., 2004). For example, some cross-sectional and longitudinal studies in developed countries (the UK and USA) using a multi-level approach have found that a "value-added" school measure (which assesses the extent to which schools achieved better than expected results and had lower than expected truancy) (Bonell, Fletcher, Jamal, Aveyard, & Markham, 2016) was consistently associated with lower rates of smoking and alcohol and drug use (Aveyard, Markham, & Cheng, 2004; Aveyard, Markham, Lancashire et al., 2004; Markham et al., 2008; Tobler, Komro, Dabroski, Aveyard, & Markham, 2011). When available, this or other school contextual factors should be assessed considering the influence of students' context.

Additionally, it is important to explore some of these school-related factors in other countries. We recently found an association between school-level factors, such as school bonding, school truancy, and school achievement, and smoking (Gaete, Ortuzar, Zitko, Montgomery, & Araya, 2016). However, in this study, and using a different methodology and additional data from the schools, the objective was to determine the association between individual and truly contextual school-related variables and having used tobacco, alcohol, or cannabis within the 30 days preceding the study, considering the hierarchical nature of students nested in schools.

2. Methods

2.1. Participants

This study used the Seventh National School Survey of Substance Use (2007) (Servicio Nacional para la Prevención y Rahabilitación de Drogas y Alcohol (SENDA), 2007) and the school data provided by the Ministry of Education of Chile. The School Surveys of Substance Use have been carried out by the government of Chile every two years beginning in 1999. In addition, individual self-report data were gathered from a nationally representative sample of 8th- (13–14 years old) to 12th-graders (17–18 years old). The 2007 survey collected data from 52,145 students attending 1512 schools. These data are

especially valuable because they contain information regarding several personal, peer, family, and school factors not all available in more recent surveys in addition to information about substance use.

We also collected school data independent of student reports from the Chilean Ministry of Education (MINEDUC) regarding several school features and achievement on school national tests.

2.2. Measures

2.2.1. Individual-level independent variables

The students' questionnaire included items comprising several domains of students' lives (e.g., personal, peer, family, school) coming from different sources such as "The Monitoring The Future Survey" (Johnston et al., 2016) and recommendations made by the United Nations Office on Drugs and Crime for conducting school surveys (United Nations Office on Drugs and Crime (UNODC), 2003). It has also been validated in a wide range of settings (Johnston, Driessen, & Kokkevi, 1994).

The personal domain included the following variables: sex; age; religiosity (How often do you go to religious services? 1 = Never or almost never to 3 = Weekly); amount of pocket money available each month (1 = Less than 5000 CLP to 5 = More than 50,000 CLP); physical exercise (How many days in the last week did you do intensive physical exercise for at least 20 min after school time? 0–7 days); and onset age of cigarette, alcohol, or cannabis use (answered for each substance, 0 = Never; 1 > 14 years old; 2 = 10–14 years old; 3 < 10 years old). Onset age of substance use was considered an independent variable only for the non-correspondent substance use (e.g., onset age of cigarette use was included in models to predict alcohol and cannabis use but not in cigarette use models). Finally, we built three variables for each substance related to the risk perception of using cigarettes (2 items, alpha = 0.65), alcohol (3 items, alpha = 0.72), or cannabis (2 items, alpha = 0.83), summing the answers of the items related to the same substance; for example, in the case of cigarette use, the students were asked to assess the risk (1 = A great risk to 5 = No risk at all) of use for a person who i) smoked frequently or ii) smoked 20 or more cigarettes a day. Each risk perception variable was included in the analyses predicting the corresponding substance.

The peer domain included the following variables: "How much time do you spend with friends?" (0 = Occasionally to 3 = Almost every day), "How many of your friends use alcohol?" (0 = None to 4 = All or almost all), and "How many of your friends smoke cannabis?" (0 = None to 4 = All or almost all).

The family domain included the following variables: family structure (0 = Parents living apart and 1 = Parents living together), mother and father education level (answered from 1 = Primary to 5 = Higher education, University/college), number of books at home (answered from 1 = None to 6 ≥ 200), parental monitoring ("How often does your mother or father know where you are after school and during weekends?" 1 = Never to 3 = Always), "How aware are your parents about your school activities?" (1 = Not at all to 4 = Very aware), "How well do your parents know your friends?" (1 = Not at all to 3 = Very well), "How is your relationship with your father? With your mother?" (1 = Awful to 5 = Excellent), parental reactions to students' alcohol and cannabis use (four items were combined in this variable with answers from 1 = Extremely angry to 5 = Not bothered at all; alpha = 0.73), history of parental drug use (0 = No, 1 = Yes), daily parental smoking (0 = No, 1 = Yes), and father and mother alcohol use (answered from 1 = Never drinks alcohol to 5 = More than two drinks of alcohol every day).

The school domain included the following variables: school bonding (three items were combined into this variable: i) "How happy are you to go to school?" 1 = Not at all to 5 = Very happy, ii) "Do you feel part of your school?" 1 = No and 2 = Yes, and iii) "How good is the relationship between you and your teachers at school?" 1 = Awful to 5 = Very good; alpha = 0.54), self-reported academic performance (grade point average [GPA] scale in Chile goes from 1 to 7 where 7 is the highest GPA and 4 is the minimum score for approval; possible answers were 1 < 4.5, 2 = 4.5 to 4.9, 3 = 5.0 to 5.4, 4 = 5.5 to 5.9, 5 = 6.0 to 6.4, and 6 = 6.5 to 7.0), academic expectations (two items were combined: "How probable is it that you will finish secondary school?" and "How probable is it that you will go to university or college?" 1 = Impossible to 5 = Highly probable; alpha = 0.51); truancy ("During the current academic year, how often did you skip school without an excuse?" 1 = Never to 4 = Many times), bullying others (five items were combined in a single scale on which students were asked about actions against other students with the intention to produce harm [e.g., hitting other students] on a regular basis [two or more times]; high scores mean being involved in more frequent actions against others; alpha = 0.60), being a victim of bullying (five items were combined in a single scale on which students were asked if they had been the subject of aggressive actions from other students on a regular basis [two or more times]; high scores mean having suffered more frequent aggressive actions from others; alpha = 0.51), teachers smoking (0 = No, 1 = Yes), perception of selling and passing drugs at/around school (0 = No, 1 = Yes), and perception of using drugs at/around school (0 = No, 1 = Yes).

2.2.2. School-level independent variables

School achievement. Each year, Chilean schools are required to conduct national achievement tests in the following subjects: Math, Language, Natural Sciences, and Social Sciences. We obtained the results for most of the schools included in this study from both 2007 and 2008. (Not all years are assessed at the same schools and grades, so we could not include the results from a single year without reducing our sample significantly.) To avoid collinearity in later analyses, we performed a preliminary correlation analysis testing the idea that most of these test results could be highly correlated. This preliminary analysis showed a correlation between Math and Language of $r = 0.94$, $p < 0.0001$; between Math and Natural Sciences of $r = 0.95$, $p < 0.0001$; and between Math and Social Sciences of $r = 0.93$, $p < 0.0001$. Therefore, we decided to include only the results from math tests in our final analysis. To facilitate interpretation, we categorized the results into three groups: Low achievement (lower tercile), Medium achievement (middle tercile), and High achievement (higher tercile).

The following variables were obtained from the MINEDUC registry:

1) School location: 0 = Urban; 1 = Rural
2) School denomination: 0 = Non-religious; 1 = Religious
3) School sex composition: 1 = Only girls; 2 = Co-educational; 3 = Only boys
4) School type (a proxy variable for socio-economic status due to the highly segregated Chilean Educational System): 1 = Municipal (Low income families); 2 = Subsidized (Medium income families); 3 = Private (High income families)
5) School size: Schools were divided into three groups (small, medium, large) according to the number of students attending.

2.2.3. Dependent variables

We used a frequency measure of substance use, asking students on how many days during the 30 days prior to the study they had used tobacco, alcohol, and cannabis. Then, we categorized the answers into two possibilities: 0 = Not user and 1 = User. This is a standard and recommend time interval used in school surveys to define current users (United Nations Office on Drugs and Crime (UNODC), 2003), and the binary approach is widely used, allowing us to compare our results with other studies (Hibell et al., 2012; Johnston et al., 2016).

2.3. Statistical analyses

General descriptive statistics were used to characterize the sample. The association between variables was assessed using multilevel logistic regression models for each substance. Multilevel modeling is the correct approach when analyzing hierarchical data as shown by Paul Aveyard and colleagues (Aveyard, Markham, & Cheng, 2004; Aveyard, Markham, Lancashire et al., 2004): students (individual level) nested into schools (school level). Four main models were built for each substance: a null model, which simply determined the intra-class correlation according to the variance found among all schools (school context); unadjusted models, which explored univariable associations; Model 1, which included only variables for each individual-level domain (Personal, Peers, Family, School) or the school-level variables found associated to the dependent variable in the univariable analysis at a significant level of $p < 0.05$; and a full model including all variables (individual- and school-level) associated at a significant level ($p < 0.05$) from Model 1. Sex and age are included in all full models regardless of the strength of the association reached in other models because they are considered important confounding variables.

All analyses were performed in Stata 12.1, using the xtlogit command.

3. Results

3.1. Descriptive statistics

A total of 45,273 students nested in 1465 schools were included in the analyses: 51.1% were female, the mean age was 15.5 (SD = 1.5), 40.9% attended municipal schools, 51.9% attended subsidized schools, and 7.3% attended private schools. Descriptive data for all independent variables are shown in a Supplementary Table.

Alcohol was the substance most frequently used in the 30 days preceding the study (48%), followed by cigarette smoking (40%) and cannabis use (12%). A more detailed description of the data from students is reported elsewhere (Gaete et al., 2016).

3.2. Intra-cluster correlation

School-level context, with no explanatory variables, seems to be responsible for 8.1% of smoking behavior, 11.6% of drinking behavior, and 15% of the cannabis use. In fully adjusted models, a small fraction of the variance of substance use behavior remained unexplained (2.4% for smoking, 2.0% for drinking, and 3.0% for cannabis use).

3.3. Tobacco use and associated factors

Cigarette smoking was associated with several individual-level variables and some school-level features. Students who were female, had more pocket money, practiced less physical exercise, had started to drink alcohol and cannabis at an early age, spent more time with friends, had more friends who use alcohol, had less parental monitoring, had poorer relationships with parents, had parents with history of drug use, had parents who currently smoke cigarettes, had a poorer personal academic performance, had frequent truancy, and had bullied others had a higher risk of smoking cigarettes during the 30 days preceding the study. Additionally, students who attended private schools and schools with poorer school achievement had a higher likelihood of being smokers. See Tables 1–5.

Table 1
Multilevel multivariable logistic regression analyses regarding personal individual-level predictors of cigarette smoking, alcohol use, and cannabis smoking, including the variables presented in Tables 2–5.

	Cigarette smoking			Alcohol use			Cannabis smoking		
	Unadjusted	Model 1	Full model	Unadjusted	Model 1	Full model	Unadjusted	Model 1	Full model
Individual-level variables	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Personal									
Sex (ref. Male)	**1.32** (1.27–1.38)	**1.43** (1.36–1.50)	**1.61** (1.52–1.71)	1.03 (0.99–1.08)	1.01 (0.97–1.07)	**1.16** (1.09–1.22)	**0.74** (0.69–0.79)	**0.71** (0.66–0.77)	**0.88** (0.80–0.96)
Age	**1.31** (1.29–1.33)	**1.10** (1.08–1.12)	0.99 (0.97–1.02)	**1.47** (1.45–1.49)	**1.32** (1.30–1.34)	**1.19** (1.16–1.22)	**1.39** (1.35–1.42)	**1.29** (1.25–1.32)	**1.10** (1.06–1.14)
Religiosity	**0.89** (0.87–0.90)	**0.94** (0.92–0.96)	0.99 (0.97–1.01)	**0.87** (0.85–0.88)	**0.91** (0.90–0.93)	**0.96** (0.94–0.97)	**0.90** (0.88–0.92)	1.02 (0.99–1.04)	
Pocket money (ref. <5000 CLP)	**1.22** (1.20–1.24)	**1.12** (1.10–1.14)	**1.09** (1.07–1.11)	**1.22** (1.20–1.24)	**1.10** (1.08–1.12)	**1.04** (1.02–1.07)	**1.27** (1.24–1.30)	**1.14** (1.11–1.17)	**1.06** (1.03–1.10)
Physical exercise	**0.94** (0.93–0.95)	**0.97** (0.96–0.98)	**0.96** (0.95–0.97)	**0.96** (0.95–0.97)	**0.99** (0.98–0.99)	**0.98** (0.96–0.99)	**0.97** (0.96–0.99)	1.00 (0.98–1.02)	
Cigarette age onset									
Never				1	1	1	1	1	1
>14 years old				**6.30** (5.88–6.74)	**3.42** (3.18–3.68)	**2.92** (2.67–3.18)	**6.00** (5.26–6.86)	**2.66** (2.29–3.09)	**2.13** (1.78–2.54)
10–14 years old				**5.99** (5.69–6.30)	**4.17** (3.95–4.40)	**3.04** (2.85–3.24)	**8.34** (7.42–9.36)	**3.64** (3.19–4.15)	**2.40** (2.05–2.80)
<10 years old				**6.26** (5.63–6.96)	**4.00** (3.56–4.48)	**2.84** (2.47–3.26)	**13.08** (11.17–15.31)	**5.56** (4.65–6.65)	**2.92** (2.34–3.64)
Alcohol age onset									
Never	1	**1**	1				1	1	1
>14 years old	**7.28** (6.80–7.79)	**4.45** (4.12–4.80)	**3.87** (3.55–4.22)				**5.69** (4.99–6.48)	**1.98** (1.63–2.20)	**1.71** (1.44–2.04)
10–14 years old	**7.29** (6.86–7.75)	**4.51** (4.23–4.81)	**3.60** (3.34–3.88)				**8.17** (7.24–9.22)	**2.92** (2.55–3.35)	**2.09** (1.78–2.46)
<10 years old	**5.59** (4.95–6.32)	**3.36** (2.93–3.85)	**2.61** (2.23–3.05)				**10.23** (8.55–12.25)	**3.54** (2.88–4.34)	**2.40** (1.88–3.08)
Cannabis age onset									
Never	1	**1**	1	1	1	1			
>14 years old	**8.70** (8.12–9.33)	**5.36** (4.97–5.77)	**3.38** (3.10–3.69)	**7.40** (6.86–7.98)	**3.57** (3.30–3.87)	**2.32** (2.11–3.18)			
10–14 years old	**8.56** (7.90–9.28)	**5.70** (5.24–6.21)	**3.17** (2.86–3.50)	**6.73** (6.19–7.32)	**4.07** (3.73–4.44)	**3.04** (2.85–3.24)			
<10 years old	**9.49** (6.87–13.09)	**7.00** (5.00–9.83)	**5.45** (3.66–8.14)	**8.30** (5.86–11.75)	**5.97** (4.14–8.62)	**4.64** (2.93–7.34)			
Risk perception of cigarette use	**1.13** (1.11–1.14)	**1.15** (1.14–1.16)	**1.10** (1.08–1.11)						
Risk perception of alcohol use				**1.04** (1.04–1.05)	**1.04** (1.03–1.05)	**1.02** (1.01–1.03)			
Risk perception of cannabis use							**1.48** (1.46–1.50)	**1.39** (1.37–1.41)	**1.25** (1.23–1.27)

Note: Age onset was assessed only for the other two substances; risk perception was assessed for the specific substance (for example, the risk perception for cigarette use was assessed only for cigarette smoking). Significant odds ratios (ORs) are shown in **bold** ($p \leq 0.001$). Empty cells indicate that the variables did not enter into the model. Results from full models presented in Tables 1–5 should not be interpreted separately.

3.4. Alcohol use and associated factors

Regarding personal factors, we found that female and older students, students who had more pocket money to spend every month, those who started to use cigarette and cannabis at an early age, and those who perceived alcohol use as less risky were more likely to have reported drinking alcohol in the 30 days preceding the study. On the contrary, those students who attended religious services more often were less likely to have used alcohol in the 30 days preceding the study.

Spending more time with friends, especially if these friends drank alcohol, is associated with a higher probability of drinking. However, students who reported that their friends used cannabis were less likely to drink alcohol.

Students with parents who knew where they were after school were less likely to drink alcohol. Students with parents who had a history of drug use, currently drank alcohol, and/or did not mind if the students used alcohol or cannabis had a higher risk for drinking in the 30 days preceding the study. We also found a slightly higher probability of drinking if the student lived in a household with a higher number of books.

The individual-level school-related factors associated with drinking were poorer school bonding, higher level of truancy in the current academic year, and a history of bullying other students.

Table 2
Multilevel multivariable logistic regression analyses regarding peer individual-level predictors of cigarette smoking, alcohol use, and cannabis smoking, including the variables presented in Tables 1, 3–5.

	Cigarette smoking			Alcohol use			Cannabis smoking		
	Unadjusted	Model 1	Full model	Unadjusted	Model 1	Full model	Unadjusted	Model 1	Full model
Individual-level variables	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Peer									
Time spent with friends									
Occasional	1	1	1	1	1	1	1	1	1
Only weekends	**1.84** (1.72–1.96)	**1.69** (1.58–1.81)	**1.57** (1.45–1.70)	**1.74** (1.63–1.85)	**1.57** (1.47–1.68)	**1.40** (1.29–1.52)	**2.05** (1.83–2.29)	**1.94** (1.71–2.19)	**1.74** (1.51–2.02)
Some weekdays/ weekends	**2.26** (2.14–2.38)	**1.88** (1.78–1.98)	**1.64** (1.53–1.74)	**2.32** (2.20–2.44)	**1.92** (1.81–2.02)	**1.60** (1.50–1.71)	**2.63** (2.39–2.90)	**2.17** (1.96–2.41)	**1.72** (1.52–1.95)
Almost everyday	**3.75** (3.52–4.00)	**2.74** (2.56–2.94)	**1.96** (1.80–2.14)	**3.35** (3.14–3.57)	**2.30** (2.15–2.47)	**1.71** (1.57–1.87)	**6.05** (5.47–6.70)	**3.98** (3.56–4.44)	**2.35** (2.06–2.68)
Alcohol use by friends									
None	1	1	1	1	1	1	1	1	1
Less than half of them	**2.83** (2.66–3.00)	**2.28** (2.14–2.43)	**1.67** (1.55–1.70)	**3.42** (3.23–3.63)	**2.97** (2.79–3.16)	**2.18** (2.02–2.34)	**3.20** (2.79–3.67)	**1.43** (1.23–1.65)	1.00 (0.84–1.19)
Half of them	**3.14** (2.93–3.36)	**2.43** (2.26–2.62)	**1.85** (1.70–2.03)	**3.78** (3.54–4.03)	**3.35** (3.12–3.60)	**2.38** (2.18–2.60)	**4.78** (4.16–5.49)	**1.56** (1.34–1.83)	0.99 (0.82–1.18)
More than half of them	**6.16** (5.68–6.68)	**3.81** (3.49–4.16)	**2.32** (2.09–2.58)	**9.74** (8.96–10.59)	**7.19** (6.57–7.87)	**4.11** (3.68–4.59)	**9.94** (8.61–11.47)	**2.11** (1.79–2.49)	1.06 (0.88–1.28)
All or almost all	**9.27** (8.65–9.93)	**5.30** (4.91–5.73)	**2.71** (2.46–2.98)	**15.53** (14.45–16.69)	**11.20** (10.32–12.14)	**5.27** (4.77–5.82)	**16.64** (14.62–18.94)	**2.73** (2.35–3.17)	1.13 (0.95–1.35)
Cannabis use by friends									
None	1	1	1	1	1	1	1	1	1
Less than half of them	**3.30** (3.14–3.47)	**1.95** (1.85–2.06)	**1.23** (1.15–1.32)	**3.24** (3.08–3.41)	**1.60** (1.51–1.69)	1.04 (0.96–1.11)	**8.11** (7.35–8.94)	**5.61** (5.04–6.25)	**3.16** (2.80–3.57)
Half of them	**1.97** (1.86–2.08)	**1.25** (1.17–1.33)	0.91 (0.84–0.99)	**1.89** (1.78–2.00)	0.99 (0.93–1.06)	**0.79** (0.72–0.85)	**7.19** (6.46–7.99)	**5.45** (4.84–6.12)	**3.59** (3.14–4.10)
More than half of them	**5.74** (5.13–6.42)	**2.55** (2.26–2.86)	1.08 (0.93–1.26)	**5.51** (4.89–6.21)	**1.79** (1.57–2.03)	**0.79** (0.67–0.93)	**40.15** (35.23–45.76)	**23.03** (19.94–26.58)	**9.92** (8.39–11.73)
All or almost all	**6.85** (6.16–7.62)	**2.70** (2.40–3.03)	1.02 (0.88–1.18)	**5.50** (4.93–6.14)	**1.48** (1.31–1.67)	**0.65** (0.56–0.77)	**59.37** (52.36–67.30)	**31.14** (27.07–35.82)	**12.36** (10.47–14.60)

Note: Significant odds ratios (ORs) are shown in **bold** ($p \leq 0.001$). Empty cells indicate that the variables did not enter into the model. Results from full models presented in Tables 1–5 should not be interpreted separately.

Students who attended private schools and schools with higher academic achievement had a higher risk of drinking. See Tables 1–5.

3.5. Cannabis use and associated factors

Female and younger students had a lower risk for cannabis use. However, those students who had pocket money and who started to use alcohol and tobacco at an earlier age had a higher risk of cannabis use. Similarly, students who had a lower perception of cannabis use had a higher risk of using it.

Students who spent more time with friends, especially if these friends used cannabis, had a higher risk for cannabis use.

Students who lived with both parents and those with parents who knew where they were had a lower risk for cannabis use. On the contrary, those students who had parents with history of drug use, who smoked cigarettes, and who did not mind if their children used alcohol or cannabis had a higher likelihood of having used cannabis in the 30 days preceding the study.

Students with poorer academic performance, higher level of truancy, history of bullying others and, a higher perception of selling or passing drugs at or around schools had a higher likelihood of cannabis use.

Regarding school-level factors, only students who attended schools with higher school academic performance had a lower risk for cannabis use.

See Tables 1–5.

4. Discussion

This study aimed to identify individual-level and truly school-level factors related to cigarette smoking, alcohol use, and cannabis use among a nationally representative sample of Chilean adolescents by performing a secondary cross-sectional multilevel analysis of the 7th National School Survey of Substance Use (2007) and including truly contextual school variables.

First, we found that a large proportion of students used cigarettes, alcohol, and/or cannabis during the 30 days preceding the survey. This is an important public health problem in Chile, and the Government is exploring options to implement effective preventive measures in the short term. The reduction of tobacco, alcohol and illegal drugs have been included as part

Table 3
Multilevel multivariable logistic regression analyses regarding family individual-level predictors of cigarette smoking, alcohol use, and cannabis smoking, including the variables presented in Tables 1, 2, 4 and 5.

	Cigarette smoking			Alcohol use			Cannabis smoking		
	Unadjusted	Model 1	Full model	Unadjusted	Model 1	Full model	Unadjusted	Model 1	Full model
Individual-level variables	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Family									
Family structure									
Parents living apart	1	1	1	1	1		1	1	1
Parents living together	**0.72** (0.69 −0.75)	**0.90** (0.86 −0.95)	0.92 (0.87 −0.98)	**0.83** (0.80 −0.87)	1.04 (0.98 −1.10)		**0.71** (0.66 −0.75)	**0.89** (0.82 −0.96)	**0.86** (0.78 −0.94)
Education of mother	1.00 (0.98 −1.01)			**1.06** (1.04 −1.07)	1.01 (0.99 −1.03)		0.99 (0.96 −1.01)		
Education of father	0.99 (0.97 −1.00)			**1.05** (1.04 −1.07)	1.03 (1.01 −1.06)	1.00 (0.98 −1.02)	0.99 (0.97 −1.02)		
Number of books at home	**0.96** (0.95 −0.98)	0.98 (0.96 −1.00)		**1.03** (1.02 −1.05)	**1.06** (1.04 −1.08)	**1.04** (1.02 −1.06)	**0.95** (0.92 −0.97)	**0.95** (0.93 −0.98)	0.97 (0.94 −1.00)
Parents know where you are	**0.57** (0.55 −0.59)	**0.69** (0.66 −0.71)	**0.90** (0.86 −0.95)	**0.54** (0.52 −0.56)	**0.64** (0.62 −0.67)	**0.84** (0.80 −0.88)	**0.44** (0.42 −0.46)	**0.54** (0.51 −0.57)	**0.85** (0.79 −0.90)
Parents know about school activities	**0.64** (0.61 −0.67)	0.94 (0.86 −1.00)		**0.62** (0.59 −0.65)	**0.91** (0.85 −0.96)	1.02 (0.95 −1.09)	**0.56** (0.52 −0.59)	0.92 (0.85 −0.99)	1.08 (0.99 −1.19)
Parents know your friends	**0.86** (0.84 −0.89)	1.04 (0.99 −1.07)		**0.88** (0.85 −0.90)	1.05 (1.01 −1.08)	1.02 (0.98 −1.07)	**0.79** (0.76 −0.83)	1.00 (0.95 −1.06)	
Relationship with father	**0.75** (0.74 −0.77)	**0.88** (0.86 −0.91)	**0.94** (0.92 −0.96)	**0.79** (0.78 −0.81)	**0.91** (0.89 −0.94)	0.98 (0.95 −1.00)	**0.76** (0.74 −0.78)	**0.94** (0.90 −0.97)	1.02 (0.98 −1.06)
Relationship with mother	**0.76** (0.75 −0.78)	**0.88** (0.86 −0.91)	**0.95** (0.92 −0.97)	**0.78** (0.77 −0.80)	**0.90** (0.87 −0.92)	0.96 (0.93 −0.99)	**0.76** (0.73 −0.78)	**0.92** (0.89 −0.96)	1.01 (0.96 −1.05)
Parental reactions to drug use	**1.55** (1.51 −1.59)	**1.30** (1.26 −1.34)	1.01 (0.98 −1.05)	**1.77** (1.73 −1.82)	**1.55** (1.50 −1.60)	**1.24** (1.19 −1.28)	**2.13** (2.06 −2.21)	**1.77** (1.70 −1.84)	**1.24** (1.19 −1.30)
History of parental drug use	**1.68** (1.64 −1.72)	**1.42** (1.38 −1.46)	**1.10** (1.06 −1.13)	**1.67** (1.63 −1.71)	**1.42** (1.38 −1.46)	**1.10** (1.06 −1.13)	**2.10** (2.02 −2.17)	**1.74** (1.67 −1.82)	**1.24** (1.19 −1.30)
Parental daily smoking	**1.83** (1.76 −1.91)	**1.54** (1.47 −1.61)	**1.42** (1.35 −1.50)	**1.49** (1.43 −1.55)	**1.14** (1.09 −1.19)	0.96 (0.91 −1.02)	**1.72** (1.61 −1.83)	**1.25** (1.16 −1.35)	**1.11** (1.02 −1.21)
Father alcohol use	**1.29** (1.26 −1.32)	**1.08** (1.05 −1.11)	1.05 (1.01 −1.08)	**1.43** (1.39 −1.47)	**1.19** (1.16 −1.23)	**1.15** (1.11 −1.19)	**1.28** (1.24 −1.33)	1.03 (0.98 −1.07)	
Mother alcohol use	**1.30** (1.26 −1.34)	**1.07** (1.04 −1.12)	0.99 (0.95 −1.03)	**1.59** (1.55 −1.65)	**1.32** (1.27 −1.38)	**1.28** (1.22 −1.33)	**1.35** (1.29 −1.41)	1.02 (0.95 −1.08)	

Note: Significant odds ratios (ORs) are shown in **bold** ($p \leq 0.001$). Empty cells indicate that the variables did not enter into the model. Results from full models presented in Tables 1–5 should not be interpreted separately.

Table 4
Multilevel multivariable logistic regression analyses regarding school-related individual-level predictors of cigarette smoking, alcohol use, and cannabis smoking, including the variables presented in Tables 1–3 and 5.

	Cigarette smoking			Alcohol use			Cannabis smoking		
	Unadjusted	Model 1	Full model	Unadjusted	Model 1	Full model	Unadjusted	Model 1	Full model
Individual-level variables	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
School									
School bonding	**0.82** (0.81 −0.83)	**0.92** (0.91 −0.94)	1.01 (0.99 −1.02)	**0.82** (0.81 −0.83)	**0.90** (0.89 −0.91)	**0.97** (0.95 −0.99)	**0.74** (0.73 −0.75)	**0.89** (0.87 −0.90)	**0.96** (0.94 −0.99)
Academic performance	**0.68** (0.66 −0.69)	**0.75** (0.74 −0.77)	**0.81** (0.79 −0.83)	**0.80** (0.79 −0.82)	**0.90** (0.88 −0.92)	1.04 (1.01 −1.07)	**0.61** (0.59 −0.63)	**0.73** (0.71 −0.76)	**0.84** (0.80 −0.87)
Academic expectations	**0.87** (0.86 −0.88)	1.01 (1.00 −1.03)		**0.92** (0.91 −0.93)	**1.04** (1.02 −1.06)	1.02 (0.99 −1.04)	**0.80** (0.79 −0.82)	**0.98** (0.96 −1.00)	0.98 (0.95 −1.00)
Truancy	**2.37** (2.30 −2.45)	**1.90** (1.84 −1.98)	**1.28** (1.23 −1.34)	**2.40** (2.32 −2.48)	**1.97** (1.90 −2.05)	**1.23** (1.18 −1.29)	**2.83** (2.73 −2.94)	**2.07** (1.99 −2.16)	**1.43** (1.36 −1.50)
Bullying others	**1.42** (1.39 −1.44)	**1.20** (1.17 −1.22)	**1.09** (1.06 −1.12)	**1.46** (1.43 −1.49)	**1.27** (1.24 −1.30)	**1.10** (1.07 −1.14)	**1.74** (1.69 −1.78)	**1.42** (1.38 −1.46)	**1.16** (1.12 −1.21)
Being bullied	**1.18** (1.15 −1.20)	1.00 (0.97 −1.02)		**1.14** (1.12 −1.17)	**0.95** (0.92 −0.97)	1.00 (0.97 −1.03)	**1.25** (1.21 −1.29)	**0.92** (0.89 −0.95)	1.02 (0.98 −1.07)
Teachers smoking	**1.28** (1.22 −1.35)	0.92 (0.87 −0.97)	0.93 (0.87 −0.99)	**1.39** (1.32 −1.46)	1.00 (0.95 −1.06)		**1.77** (1.65 −1.90)	1.04 (0.96 −1.12)	
Perception of selling/ passing drugs	**0.49** (0.47 −0.51)	**0.77** (0.73 −0.81)	0.94 (0.88 −1.00)	**0.49** (0.47 −0.52)	**0.78** (0.73 −0.82)	0.98 (0.91 −1.05)	**0.32** (0.30 −0.34)	**0.61** (0.56 (0.66)	**0.74** (0.67 −0.82)
Perception of using drugs	**0.50** (0.48 −0.52)	**0.73** (0.69 −0.77)	0.96 (0.90 −1.03)	**0.49** (0.47 −0.52)	**0.72** (0.68 −0.75)	0.92 (0.86 −0.99)	**0.34** (0.32 −0.37)	**0.65** (0.60 −0.71)	0.93 (0.84 −1.02)

Note: Significant odds ratios (ORs) are shown in **bold** ($p \leq 0.001$). Empty cells indicate that the variables did not enter into the model. Results from full models presented in Tables 1–5 should not be interpreted separately.

Table 5
Multilevel multivariable logistic regression analysis regarding school-level predictors of cigarette smoking, alcohol use, and cannabis smoking, including the variables presented in Tables 1–4.

School-level variables	Cigarette smoking				Alcohol use				Cannabis smoking			
	Null model	Unadjusted	Model 1	Full model	Null model	Unadjusted	Model 1	Full model	Null model	Unadjusted	Model 1	Full model
		OR (95% CI)	OR (95% CI)	OR (95% CI)		OR (95% CI)	OR (95% CI)	OR (95% CI)		OR (95% CI)	OR (95% CI)	OR (95% CI)
School location												
Urban		1	1	1		1	1	1		1		
Rural		0.79 (0.64–0.98)	0.74 (0.60–0.90)	1.09 (0.89–1.33)		**0.67** (0.53–0.84)	0.75 (0.60–0.94)	1.07 (0.87–1.31)		0.75 (0.54–1.04)		
School denomination												
Non-religious		1	1			1	1			1	1	1
Religious		0.90 (0.83–0.98)	0.94 (0.86–1.02)			1.10 (1.01–1.21)	0.93 (0.84–1.02)			**0.71** (0.63–0.80)	**0.80** (0.70–0.90)	1.04 (0.93–1.17)
School sex composition												
Only girls		1	1			1				1	1	1
Co-educational		0.95 (0.84–1.08)	0.90 (0.80–1.01)			0.93 (0.81–1.07)				**1.47** (1.21–1.77)	1.27 (1.06–1.52)	1.05 (0.88–1.25)
Only boys		0.81 (0.66–0.99)	0.85 (0.70–1.03)			1.17 (0.93–1.48)				1.47 (1.09–2.00)	**1.64** (1.23–2.17)	0.89 (0.67–1.15)
School type												
Municipal		1	1	1		1	1	1		1	1	1
Subsidized		0.99 (0.92–1.07)	**1.17** (1.08–1.27)	0.95 (0.89–1.02)		**1.36** (1.25–1.48)	**1.45** (1.32–1.59)	**1.13** (1.05–1.21)		0.94 (0.84–1.05)	**1.24** (1.10–1.39)	0.99 (0.89–1.10)
Private		**0.81** (0.71–0.92)	1.10 (0.95–1.28)	**0.79** (0.69–0.90)		**2.20** (1.90–2.54)	**2.36** (1.99–2.79)	**1.49** (1.30–1.71)		**0.66** (0.54–0.81)	1.20 (0.96–1.50)	0.89 (0.72–1.10)
School size												
Small		1				1	1	1		1		
Medium		1.04 (0.95–1.12)				1.12 (1.02–1.23)	**1.16** (1.07–1.28)	1.10 (1.02–1.18)		0.93 (0.82–1.05)		
Large		1.01 (0.92–1.11)				1.15 (1.04–1.28)	**1.22** (1.10–1.35)	1.08 (0.99–1.17)		0.94 (0.82–1.08)		
School achievement												
Low achievement		1	1	1		1	1	1		1	1	1
Medium achievement		**0.78** (0.72–0.85)	**0.75** (0.69–0.82)	0.89 (0.82–0.97)		0.98 (0.88–1.08)	0.87 (0.79–0.96)	1.13 (1.04–1.232)		**0.68** (0.60–0.76)	**0.66** (0.58–0.74)	**0.86** (0.77–0.96)
High achievement		**0.67** (0.62–0.73)	**0.64** (0.58–0.70)	**0.83** (0.76–0.91)		**1.29** (1.17–1.42)	0.93 (0.83–1.04)	**1.19** (1.09–1.31)		**0.49** (0.44–0.56)	**0.47** (0.41–0.54)	**0.73** (0.64–0.83)
Random intercept												
Beta (T00)	**0.29**		**0.49**	**0.28**	**0.43**		**0.61**	**0.26**	**0.58**		**0.67**	**0.32**
ICC (%)	8.1		6.9	2.4	11.6		10.1	2.0	15.0		11.9	3.0

Note: ICC = Intra-Class Correlation; significant odds ratios (ORs) are shown in **bold** ($p \leq 0.001$). Empty cells indicate that the variables did not enter into the model. Results from full models presented in Tables 1–5 should not be interpreted separately.

of the recent Chilean Health Strategic Plan for the decade 2011–2020 promoting school and community interventions (Ministerio de Salud (Chile), 2011).

Second, we found that school context seems to be responsible for an important proportion of the variance of substance use behaviors. In other words, adolescent drug use is significantly correlated with school context, especially in the case of drinking (11.6% of variance is explained by school context) and cannabis use (15.0% of variance is explained by school context). We could identify some of the variables explaining this school effect, but it appears to be mainly explained by the pupil composition of the schools rather than school features per se. There is evidence that schools differ in terms of the composition of the student body due to non-random assignment of students to different schools (Treviño, Valenzuela, & Villalobos, 2016). For example, students from high-income families are more likely than others to attend certain schools (Treviño et al., 2016). We aimed to adjust our results for this compositional effect (Castellano, Rabe-Hesketh, & Skrondal, 2014; Duncan, Jones, & Moon, 1998) by including the variable "Type of school" in the models, a proxy variable for students' socioeconomic status. However, some authors have argued that controlling for students' socioeconomic status may lead to an underestimation of the differences between schools (Castellano et al., 2014). After adjusting for individual and school variables, we found that there was still unexplained variance among schools. Some of this variance might be explained by other potentially important school-level variables to which we did not have access (e.g., school norms, school prevention policies, or teaching quality).

Most of the variables included in the early models were retained for the multivariable models. Additionally, most associations were attenuated in the fully adjusted models, probably due to confounding. Given the cross-sectional nature of the study, we cannot infer that associations represent causation. However, we have identified some factors that can be tested in causally informative designs or that can potentially be included in preventive interventions, especially because they are potentially modifiable over time.

Therefore, we were able to detect common and specific factors at the individual and school levels related to smoking cigarettes, drinking, and using cannabis, many of which have also been found associated elsewhere (Kazmer, Dzurova, Csemy, & Spilkova, 2014; Rakic, Rakic, Milosevic, & Nedeljkovic, 2014; Wang, Hipp, Butts, Jose, & Lakon, 2015).

For instance, the availability of pocket money, spending more time with friends, having parents with a history of drug use, having parents who currently smoke and who do not mind if their children use alcohol or cannabis, having a higher frequency of truancy, and actions of bullying against others all increased the probability of using any substance studied. On the other hand, students who had parents who knew where they were (parental monitoring), better bonding to their schools, better individual-level academic performance, and lower perception of selling or passing drugs in or around schools had a lower risk of using any substances. Even though the Government of Chile has spent a large amount of resources to prevent substance use among adolescents (e.g., media campaigns, universal school-based interventions), we still have neither studies aiming to test the effectiveness of interventions using randomized controlled trials nor a measure of the impact of governmental interventions in the long term.

Our findings provide valuable information to be used when planning universal preventive interventions in Chile because many of the factors identified are modifiable. Other studies have found that having bullied others is a factor associated with smoking, drinking, and cannabis use (Radliff, Wheaton, Robinson, & Morris, 2012; Vieno, Gini, & Santinello, 2011), and we have confirmed this association. In addition, there is already some evidence that school-based bullying prevention programs reduce smoking, binge drinking, and cannabis use, probably through the promotion of positive self-interest and the engagement of school staff and providing firm limits between acceptable and unacceptable behaviors (Amundsen & Ravndal, 2010). We also confirm that having parents who are interested in the activities of their children (parental monitoring) and who provide clear limits and restrictions about substance use reduce the risk for drug use (Kristjansson, James, Allegrante, Sigfusdottir, & Helgason, 2010). Having parents who have an authoritative style—that is, providing support, monitoring, and being consistent with discipline—reduces the risk for alcohol and cigarette use, antisocial behaviors, and internalizing symptoms (Luyckx et al., 2011). In addition, interventions aiming to train parents in skills to communicate clear norms against substance use reduce the use of alcohol over time (Park et al., 2000; Schofield, Conger, & Robins, 2015). Additionally, promoting school bonding and a safe environment free of drugs may also help prevent future substance use, as suggested by promising interventions (Bonell et al., 2013).

Based on our findings, we also propose the consideration of specific factors related to the risk of using some drugs (e.g., female adolescents had a higher risk for smoking and drinking, having more friends who drink alcohol increased the risk for smoking and drinking, and having more friends who used cannabis was associated with an increased risk for smoking and cannabis use but with a reduced risk for drinking) and to the specific context of Chile (for example, alcohol use was more frequent in private schools and in schools with high achievement on national tests).

We confirmed an epidemiological change found in other places: girls are using cigarettes at an equal or a higher rate than boys (Global Youth Tabacco Survey Collaborative Group, 2003) and drink alcohol more often than boys (Centers for Disease Control and Prevention, 2012). In the case of alcohol use, several reasons have been formulated explaining this phenomenon, especially the changes in social roles and expectations for women in recent decades (Wells et al., 2011), more exposure to advertisements for alcohol in magazines (Jernigan, Ostroff, Ross, & O'Hara, 2004), and an earlier age for onset of alcohol use than in boys (Cheng, Cantave, & Anthony, 2016). This is especially important because there are clear health and social consequences for women who drink as there is evidence that alcohol use increases the risk of breast cancer (Rehm et al., 2010). In addition, there is a relational link between depression and substance use that is greater in girls than boys (Schulte, Ramo, & Brown, 2009), and teenager girls who binge drink have a higher risk of becoming teen mothers (Dee, 2001).

We found some evidence that students seem to become involved with peers who use the same types of substances, suggesting some social network selection. Teen smoking prevention has been successful using leaders among peer social networks (Campbell et al., 2008), and interventions improving parental monitoring have moderated the use of alcohol, tobacco, and other drugs among early adolescents (Schofield et al., 2015). However, the mutual influences between adolescent substance use and peer network are not completely clear when examined in longitudinal studies (Cheadle, Walsemann, & Goosby, 2015). Nonetheless, preventive interventions should include social network assessment to determine the effect of positive networks.

Furthermore, our results support theories and models such as the comprehensive social influence approach (Kreeft et al., 2009). In addition, we identified an intervention ("Unplugged") that includes several components addressing the risk factors that we have found in our study: training on skills to resist pressure to use drugs and to improve communication and social skills and effective parental monitoring (Faggiano et al., 2010; Kreeft et al., 2009). This intervention is based on 12 interactive sessions delivered to students by trained teachers. There are also additional sessions for parents to strengthen three main skills related to parental monitoring and communication.

Chile has a segregated educational system (Treviño et al., 2016; Valenzuela, Bellei, & Ríos, 2014), and our findings regarding the risk for drinking alcohol among students attending schools with the highest performance in national tests may reflects this. Our study and other studies have found that, at the individual level, the more money available to spend each month, the higher the probability of using any substance of abuse. Similarly, the better the academic performance, at the individual level, the lower the risk for drug use. Therefore, one may expect that students attending schools performing very well in national tests may have a lower risk for drug use, which is true for smoking and cannabis use but not for alcohol use in our study. Alcohol consumption is the main problem among Chilean adolescents, and alcohol is probably the most available drug in the country, making its easy access, especially if students have the resources to purchase it, an urgent problem to be solved. Our findings may provide evidence of this national issue.

There are several limitations in our study. First, the cross-sectional design does not allow claiming for causality in the associations. For example, this is especially true when examining the relationship between alcohol use and attending a private school with a high school achievement in Chile, an association perhaps explained mainly by the high segregation in the educational system in Chile. Exploring causal relationships and mediating effects is better approached using longitudinal studies (Cole & Maxwell, 2003; Maxwell, Cole, & Mitchell, 2011).

The individual-level data were obtained by self-report questionnaires; thus, there is a potential recall and social desirability bias. Furthermore, the variables referring to peers' substance use were based on the perceptions of participants, which could be affected by their perception of social norms (Festinger, 1954; Perkins, 2003). Some studies have found that students might tend to overestimate the substance use by their friends or peers (Perkins, 2003). Some evidence suggests that the perception of social norms is a robust factor influencing substance among adolescents (Faggiano et al., 2010), and challenging normative beliefs about drug use appears to be effective (Faggiano et al., 2008; Faggiano et al., 2010). Other limitations refer to the lack of information regarding some well-known variables associated with substance use such as psychopathology at the individual level. Similarly, other potentially important truly contextual variables such as school climate and school policies were unavailable.

Finally, some of the independent variables included in the analyses had a less than desirable internal consistency (Clark & Watson, 1995; Nunnally, 1978; Peterson, 1994). The value of alpha can be affected by several factors such as number of items included in the scale, inter-relatedness of the items, and the dimensionally of the scale (Cortina, 1993; Tavakol & Dennick, 2011). In our study, the variables with low Cronbach's alpha had few items (e.g. school bonding, three items; academic expectations, two items). For all the cases, further research such be done to improve these scales, and explore their influence on substance use.

The statistical analysis was complex given the large number of variables and hierarchical structure of the data, including many individual- and school-level variables. In view of this, we did not plan to test for any interactions at this stage, but we are continuing the analysis with an interest in testing some interactions such as those between gender and school bonding and substance use. Future studies using a longitudinal design would be better suited to test pathways including mediation/moderation mechanisms.

5. Conclusions

This study provides awareness of the urgent necessity of local interventions for prevention of drug use considering the particularities of our society, especially regarding sex and socio-economic differences.

Competing interests

The authors declare that they have no competing interests.

Ethics approval

The Bioethical Committee of the University of the Andes approved this study on June 9, 2010. It was performed in agreement with the Declaration of Helsinki.

Funding

This study was supported by the grant FONDECYT of Initiation no. 11121541, provided by the National Commission for Scientific and Technological Research. Principal Investigator: Jorge Gaete. Dr Jorge Gaete has received an award of a Post-doctoral Research Scholarship from CONICYT (2015–2017) while conducting the final analyses of the study and writing the article.

Acknowledgments

This study conducted a secondary analysis of the 7th Chilean School Survey of Substance Use. The authors have the authorization to use this dataset from the Chilean Ministry of Interior. The authors also acknowledge the Chilean Ministry of Education for providing information about the schools included in this study.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.adolescence.2017.02.011.

References

Amundsen, E. J., & Ravndal, E. (2010). Does successful school-based prevention of bullying influence substance use among 13- to 16-year-olds? *Drugs: Education, Prevention and Policy, 17*, 42–54.
Aveyard, P., Markham, W. A., & Cheng, K. K. (2004). A methodological and substantive review of the evidence that schools cause pupils to smoke. *Social Science & Medicine, 58*, 2253–2265.
Aveyard, P., Markham, W. A., Lancashire, E., Bullock, A., Macarthur, C., Cheng, K. K., et al. (2004). The influence of school culture on smoking among pupils. *Social Science & Medicine, 58*, 1767–1780.
Battistella, G., Fornari, E., Annoni, J.-M., Chtioui, H., Dao, K., Fabritius, M., et al. (2014). Long-term effects of cannabis on brain structure. *Neuropsychopharmacology, 39*, 2041–2048.
Berge, J., Sundell, K., Öjehagen, A., & Håkansson, A. (2016). Role of parenting styles in adolescent substance use: Results from a Swedish longitudinal cohort study. *BMJ Open, 6*, e008979.
Bonell, C., Fletcher, A., Jamal, F., Aveyard, P., & Markham, W. (2016). Where next with theory and research on how the school environment influences young people's substance use? *Health Place, 40*, 91–97.
Bonell, C., Jamal, F., Harden, A., Wells, H., Parry, W., Fletcher, A., et al. (2013). Systematic review of the effects of schools and school environment interventions on health: evidence mapping and synthesis. *Public Health Res, 1*(1).
Camchong, J., Lim, K. O., & Kumra, S. (2016). *Adverse effects of cannabis on adolescent brain development: A longitudinal study. Cereb cortex* (pp. 1–9).
Campbell, R., Starkey, F., Holliday, J., Audrey, S., Bloor, M., Parry-Langdon, N., et al. (2008). An informal school-based peer-led intervention for smoking prevention in adolescence (ASSIST): A cluster randomised trial. *Lancet, 371*, 1595–1602.
Castellano, K. E., Rabe-Hesketh, S., & Skrondal, A. (2014). Composition, context, and endogeneity in school and teacher comparisons. *Journal of Educational and Behavioral Statistics, 39*, 333–367.
Centers for Disease Control and Prevention. (2012). Youth risk behavior surveillance-United States, 2011. *MMWR, 61*, 1–168.
Cheadle, J. E., Walsemann, K. M., & Goosby, B. J. (2015). Teen alcohol use and social networks: The contributions of friend influence and friendship selection. *Journal of Alcoholism and Drug dependence, 3*, 224.
Cheng, H. G., Cantave, M. D., & Anthony, J. C. (2016). Taking the first full drink: Epidemiological evidence on male-female differences in the United States. *Alcoholism Clinical and Experimental Research, 40*, 816–825.
Clark, L. A., & Watson, D. (1995). Constructing validity: Basic issues in obkective scale development. *Psychological Assessment, 7*, 309–319.
Cole, D. A., & Maxwell, S. E. (2003). Testing mediational models with longitudinal data: Questions and tips in the use of structural equation modeling. *Journal of Abnormal Psychology, 112*, 558–577.
Colver, A., & Longwell, S. (2013). New understanding of adolescent brain development: Relevance to transitional healthcare for young people with long term conditions. *Archives of Disease in Childhood, 98*, 902–907.
Cortina, J. M. (1993). What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology, 78*, 98–104.
Dee, T. S. (2001). The effects of minimum legal drinking ages on teen childbearing. *The Journal of Human Resources, 36*, 823–838.
Duncan, C., Jones, K., & Moon, G. (1998). Context, composition and heterogeneity: Using multilevel models in health research. *Social Science & Medicine, 46*, 97–117.
Ellickson, P. L., Tucker, J. S., Klein, D. J., & Saner, H. (2004). Antecedents and outcomes of marijuana use initiation during adolescence. *Preventive Medicine, 39*, 976–984.
Faggiano, F., Galanti, M. R., Bohrn, K., Burkhart, G., Vigna-Taglianti, F., Cuomo, L., et al. (2008). The effectiveness of a school-based substance abuse prevention program: Eu-dap cluster randomised controlled trial. *Preventive Medicine, 47*, 537–543.
Faggiano, F., Vigna-Taglianti, F., Burkhart, G., Bohrn, K., Cuomo, L., Gregori, D., et al. (2010). The effectiveness of a school-based substance abuse prevention program: 18-month follow-up of the EU-dap cluster randomized controlled trial. *Drug and Alcohol Dependence, 108*, 56–64.
Festinger, L. (1954). A theory of social comparison processes. *Human relations, 7*, 117–140.
Fletcher, A., Bonell, C., & Hargreaves, J. (2008). School effects on young people's drug use: A systematic review of intervention and observational studies. *Journal of Adolescent Health, 42*, 209–220.
Gaete, J., Montgomery, A., & Araya, R. (2015). The association between school bonding and smoking amongst chilean adolescents. *Substance Abuse, 36*, 515–523.
Gaete, J., Ortuzar, C., Zitko, P., Montgomery, A., & Araya, R. (2016). Influence of school-related factors on smoking among chilean adolescents: A cross-sectional multilevel study. *BMC Pediatrics, 16*, 79.
Galan, I., Diez-Ganan, L., Gandarillas, A., Mata, N., Cantero, J. L., & Durban, M. (2012). Effect of a smoking ban and school-based prevention and control policies on adolescent smoking in Spain: A multilevel analysis. *Prevention Science, 13*, 574–583.
Global Youth Tabacco Survey Collaborative Group. (2003). Differences in worldwide tobacco use by gender: Findings from the global youth tobacco survey. *Journal of School Health, 73*, 207–215.
Harakeh, Z., de Looze, M. E., Schrijvers, C. T. M., van Dorsselaer, S. A. F. M., & Vollebergh, W. A. M. (2012). Individual and environmental predictors of health risk behaviours among Dutch adolescents: The HBSC study. *Public Health, 126*, 566–573.
Hawkins, J. D., Graham, J. W., Maguin, E., Abbott, R., Hill, K. G., & Catalano, R. F. (1997). Exploring the effects of age of alcohol use initiation and psychosocial risk factors on subsequent alcohol misuse. *Journal of Studies on Alcohol and Drugs, 58*, 280–290.

Hibell, B., Guttormsson, U., Ahlstrom, S., Balakireva, O., Bjarnason, T., Kokkevi, A., et al. (2012). *The 2011 ESPAD report, substance use among students in 36 European countries*. Sweden: Monitoring Centre for Drugs and Drug Addiction (EMCDDA).
Hill, D., & Mrug, S. (2015). School-level correlates of adolescent tobacco, alcohol, and marijuana use. *Substance Use Misuse, 50*, 1518–1528.
Hox, J. (2002). *Multilevel Analysis: Techniques and applications*. New Jersey: Lawerence Erlbaum Associates.
Hughes, A., Lipari, R. N., & Williams, M. (2015). State estimates of adolescent marijuana use and perceptions of risk of harm from marijuana use: 2013 and 2014. In *The CBHSQ report: December 17, 2015. Rockville, MD.: Substance abuse and mental health services administration*. Center for Behavioral Health Statistics and Quality.
Jacobus, J., Squeglia, L. M., Bava, S., & Tapert, S. F. (2013). White matter characterization of adolescent binge drinking with and without co-occurring marijuana use: A 3-year investigation. *Psychiatry Research, 214*, 374–381.
Jaffee, S. R., Strait, L. B., & Odgers, C. L. (2012). From correlates to causes: Can quasi-experimental studies and statistical innovations bring us closer to identifying the causes of antisocial behavior? *Psychological Bulletin, 138*, 272–295.
Jernigan, D. H., Ostroff, J., Ross, C., & O'Hara, J. A., 3rd (2004). Sex differences in adolescent exposure to alcohol advertising in magazines. *Archives of Pediatrics & Adolescent Medicine, 158*, 629–634.
Johnston, L. D., Driessen, F., & Kokkevi, A. (1994). *Surveying student drug misuse: A six-country pilot study*. Strasbourg, France: Council of Europe.
Johnston, L. D., O'Malley, P. M., Miech, R. A., Bachman, J. G., & Schulenberg, J. E. (2016). *Monitoring the Future national survey results on drug use, 1975-2015: Overview, key findings on adolescent drug use*. Ann Arbor: Institute for Social Research, The University of Michigan.
Kazmer, L., Dzurova, D., Csemy, L., & Spilkova, J. (2014). Multiple health risk behaviour in Czech adolescents: Family, school and geographic factors. *Health Place, 29c*, 18–25.
Kim, H. H., & Chun, J. (2016). Examining the effects of parental influence on adolescent smoking behaviors: A multilevel analysis of the global school-based student health survey (2003-2011). *Nicotine & Tobacco Research, 18*, 934–942.
Kreeft, P. V. D., Wiborg, G., Galanti, M. R., Siliquini, R., Bohrn, K., Scatigna, M., et al. (2009). 'Unplugged': A new european school programme against substance abuse. *Drugs: Education, Prevention and Policy, 16*, 167–181.
Kristjansson, A., James, J., Allegrante, J., Sigfusdottir, I., & Helgason, A. (2010). Adolescent substance use, parental monitoring, and leisure time activities: 12-year outcomes of primary prevention in Iceland. *Preventive Medicine, 51*, 168–171.
Lisdahl, K. M., Thayer, R., Squeglia, L. M., McQueeny, T. M., & Tapert, S. F. (2013). Recent binge drinking predicts smaller cerebellar volumes in adolescents. *Psychiatry Research, 211*, 17–23.
Lubman, D. I., Cheetham, A., & Yucel, M. (2015). Cannabis and adolescent brain development. *Pharmacology & Therapeutics, 148*, 1–16.
Luciana, M. (2013). Adolescent brain development in normality and psychopathology. *Development and Psychopathology, 25*, 1325–1345.
Luyckx, K., Tildesley, E. A., Soenens, B., Andrews, J. A., Hampson, S. E., Peterson, M., et al. (2011). Parenting and trajectories of children's maladaptive behaviors: A 12-year prospective community study. *Journal of Clinical Child & Adolescent Psychology, 40*, 468–478.
Markham, W. A., Aveyard, P., Bisset, S. L., Lancashire, E. R., Bridle, C., & Deakin, S. (2008). Value-added education and smoking uptake in schools: A cohort study. *Addiction, 103*, 155–161.
Maxwell, S. E., Cole, D. A., & Mitchell, M. A. (2011). Bias in cross-sectional analyses of longitudinal mediation: Partial and complete mediation under an autoregressive model. *Multivariate Behavioral Research, 46*, 816–841.
Ministerio de Salud (Chile). (2011). *Estrategia Nacional de Salud. Para el cumplimiento de los Objectives Sanitarios de la Década 2011-2020*.
Monasterio, E. B. (2014). Adolescent substance involvement use and abuse. *Primary Care: Clinics in Office Practice, 41*, 567–585.
Moore, G. F., & Littlecott, H. J. (2015). School- and family-level socioeconomic status and health behaviors: Multilevel analysis of a national survey in wales, United Kingdom. *Journal of School Health, 85*, 267–275.
Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.
Paek, H. J., Hove, T., & Oh, H. J. (2013). Multilevel analysis of the impact of school-level tobacco policies on adolescent smoking: The case of Michigan. *Journal of School Health, 83*, 679–689.
Park, S., & Kim, Y. (2015). Prevalence, correlates, and associated psychological problems of substance use in Korean adolescents. *BMC Public Health, 16*, 79.
Park, J., Kosterman, R., Hawkins, J. D., Haggerty, K. P., Duncan, T. E., Duncan, S. C., et al. (2000). Effects of the "preparing for the drug free years" curriculum on growth in alcohol use and risk for alcohol use in early adolescence. *Prevention Science, 1*, 125–138.
Perkins, H. W. (2003). The emergence and evolution of the social norms approach to substance use prevention. In H. W. Perkins (Ed.), *The social norms approach to preventing school and college substance abuse: A handbook for educators, counselors and clinicians* (pp. 3–17). San Francisco, CA: Jossey-Bass.
Peterson, R. (1994). A meta-analysis of Cronbach's coefficient alpha. *Journal of Consumer Research, 21*, 381–391.
Radliff, K. M., Wheaton, J. E., Robinson, K., & Morris, J. (2012). Illuminating the relationship between bullying and substance use among middle and high school youth. *Addictive Behaviors, 37*, 569–572.
Rakic, D. B., Rakic, B., Milosevic, Z., & Nedeljkovic, I. (2014). The prevalence of substance use among adolescents and its correlation with social and demographic factors. *Vojnosanitetski Pregled, 71*, 467–473.
Rehm, J., Baliunas, D., Borges, G. L., Graham, K., Irving, H., Kehoe, T., et al. (2010). The relation between different dimensions of alcohol consumption and burden of disease: An overview. *Addiction, 105*, 817–843.
Ryabov, I. (2015). Relation of peer effects and school climate to substance use among Asian American adolescents. *Journal of Adolescent Research, 42*, 115–127.
Schofield, T. J., Conger, R. D., & Robins, R. W. (2015). Early adolescent substance use in Mexican origin families: Peer selection, peer influence, and parental monitoring. *Drug and Alcohol Dependence, 157*, 129–135.
Schulte, M. T., Ramo, D., & Brown, S. A. (2009). Gender differences in factors influencing alcohol use and drinking progression among adolescents. *Clinical Psychology Review, 29*, 535–547.
Servicio Nacional para la Prevención y Rahabilitación de Drogas y Alcohol (SENDA). (2007). *Séptimo Estudio Nacional de Drogas en la Población Escolar*. Santiago, Chile: Ministerio de Interior de Chile.
Servicio Nacional para la Prevención y Rahabilitación de Drogas y Alcohol (SENDA). (2013). *Décimo Estudio Nacional de Drogas en la Población Escolar*. Santiago, Chile: Ministerio de Interior de Chile.
Squeglia, L. M., Pulido, C., Wetherill, R. R., Jacobus, J., Brown, G. G., & Tapert, S. F. (2012). Brain response to working memory over three years of adolescence: Influence of initiating heavy drinking. *Journal of Studies on Alcohol and Drugs, 73*, 749–760.
Steinberg, L. (2013). Does recent research on adolescent brain development inform the mature minor doctrine? *Journal of Medicine and Philosophy, 38*, 256–267.
Stiles, J., & Jernigan, T. L. (2010). The basics of brain development. *Neuropsychology Review, 20*, 327–348.
Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education, 2*, 53–55.
Tobler, A. L., Komro, K. A., Dabroski, A., Aveyard, P., & Markham, W. A. (2011). Preventing the link between SES and high-risk behaviors: "value-added" education, drug use and delinquency in high-risk, urban schools. *Prevention Science, 12*, 211–221.
Tomczyk, S., Hanewinkel, R., & Isensee, B. (2015). Multiple substance use patterns in adolescents-A multilevel latent class analysis. *Drug and Alcohol Dependence, 155*, 208–214.
Treviño, E., Valenzuela, J. P., & Villalobos, C. (2016). Within-school segregation in the Chilean school system: What factors explain it? How efficient is this practice for fostering student achievement and equity? *Learning and Individual Differences, 51*, 367–375.
Tyas, S. L., & Pederson, L. L. (1998). Psychosocial factors related to adolescent smoking: A critical review of the literature. *Tobacco Control, 7*, 409–420.
United Nations Office on Drugs and Crime (UNODC). (2003). *GAP Toolkit Module 2: Handbook for implementing school surveys on drug abuse*. Vienna, Austria.
Valenzuela, J. P., Bellei, C., & Ríos, D. d. l (2014). Socioeconomic school segregation in a market-oriented educational system. The case of Chile. *Journal of Education Policy, 29*, 217–241.

Vieno, A., Gini, G., & Santinello, M. (2011). Different forms of bullying and their association to smoking and drinking behavior in italian adolescents. *Journal of School Health, 81*, 393–399.
Walsh, S. D., Djalovski, A., Boniel-Nissim, M., & Harel-Fisch, Y. (2014). Parental, peer and school experiences as predictors of alcohol drinking among first and second generation immigrant adolescents in Israel. *Drug and Alcohol Dependence, 138*, 39–47.
Wang, C., Hipp, J. R., Butts, C. T., Jose, R., & Lakon, C. M. (2015). Alcohol use among adolescent youth: The role of friendship networks and family factors in multiple school studies. *PLoS One, 10*, e0119965.
Wells, J. E., Haro, J. M., Karam, E., Lee, S., Lepine, J. P., Medina-Mora, M. E., et al. (2011). Cross-national comparisons of sex differences in opportunities to use alcohol or drugs, and the transitions to use. *Substance Use & Misuse, 46*, 1169–1178.
West, P., Sweeting, H., & Leyland, A. (2004). School effects on pupils' health behaviours: Evidence in support of the health promoting school. *Research Papers in Education, 19*, 261–291.
Wetherill, R., & Tapert, S. F. (2013). Adolescent brain development, substance use, and psychotherapeutic change. *Psychology of Addictive Behaviors, 27*, 393–402.
Wiium, N., Burgess, S., & Moore, L. (2011). Brief report: Multilevel analysis of school smoking policy and pupil smoking behaviour in wales. *Journal of Adolescent Research, 34*, 385–389.